



NAVAL
POSTGRADUATE
SCHOOL

Software Engineering Program

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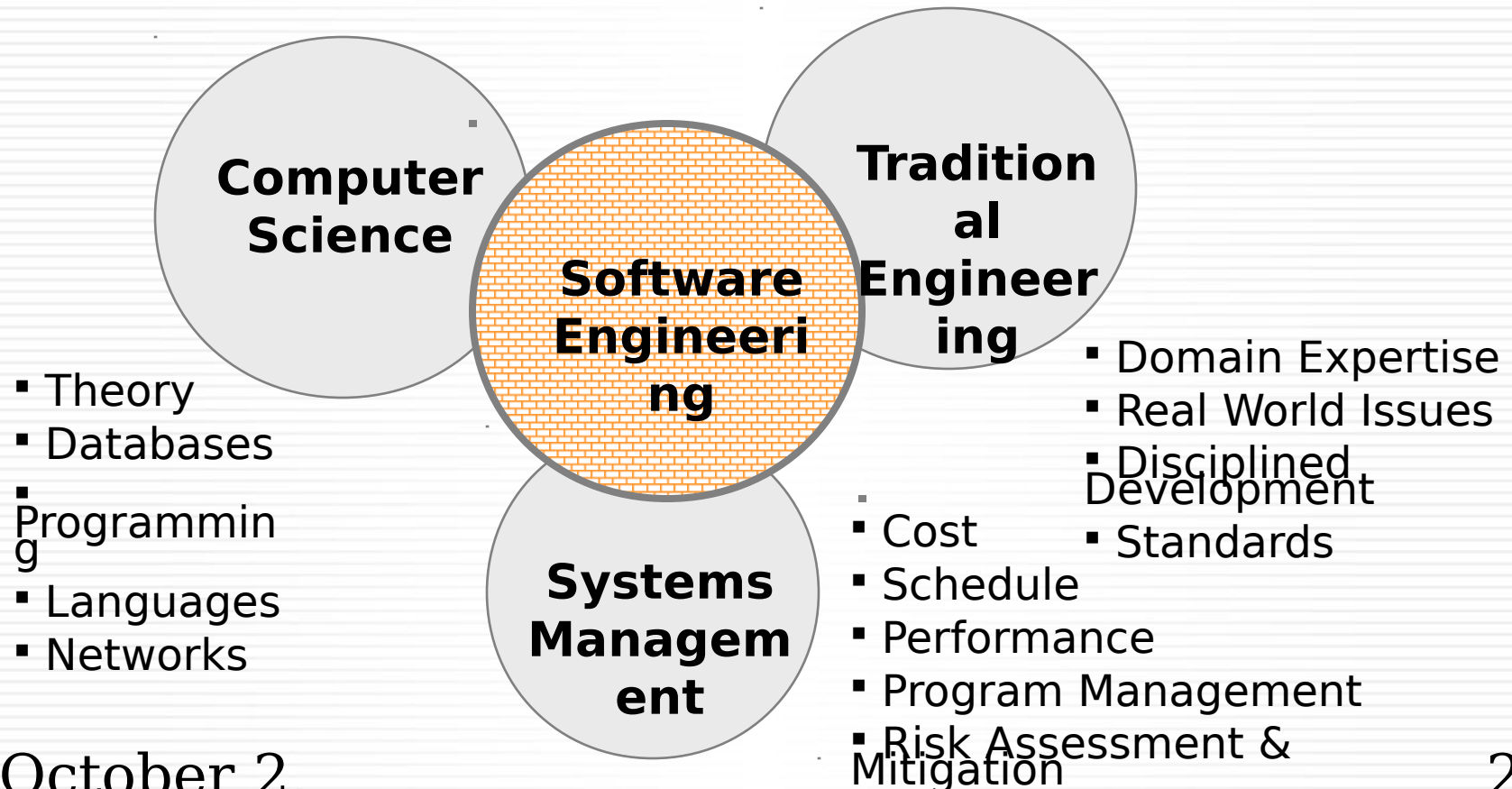
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What is Software Engineering?

Software Engineering Program

Engineering real-world software products and systems on schedule, within budget, and with the desired functionality and level of dependability (i.e., sum of the “ilities”)





Why should the DoN invest in Software Engineering Education?

Software Engineering Program

- Modern defense systems are software-intensive systems-of-systems
 - Majority of the functionality of these systems resides in software
 - Warfighter is being placed on the fringes to handle exceptions, with the rest of the system being highly automated
 - These systems need to be highly dependable
 - Realization of desirable emergent capabilities and behaviors of these systems is dependent on Software Systems Engineers
 - It takes engineers and other acquisition professionals with expertise in software engineering to do this ("the Devil is in the detail")
- Too few government personnel—civilian and military—with deep knowledge and honed problem-solving skills in Software Engineering
 - Software system acquisition in DoD is infamous for program cost and schedule overruns, poor system quality, missing capabilities, etc.



Software Engineering Program

The NPS Software Engineering Program offers graduate education in the principles and practices of software engineering with thesis options of military relevance and significance

We combine a systems perspective with modeling and design at all levels of levels of representation from capabilities and requirements down to executable code



Program Objectives

Software Engineering Program

Provide military and civilian graduate students with study in all the relevant levels of software development

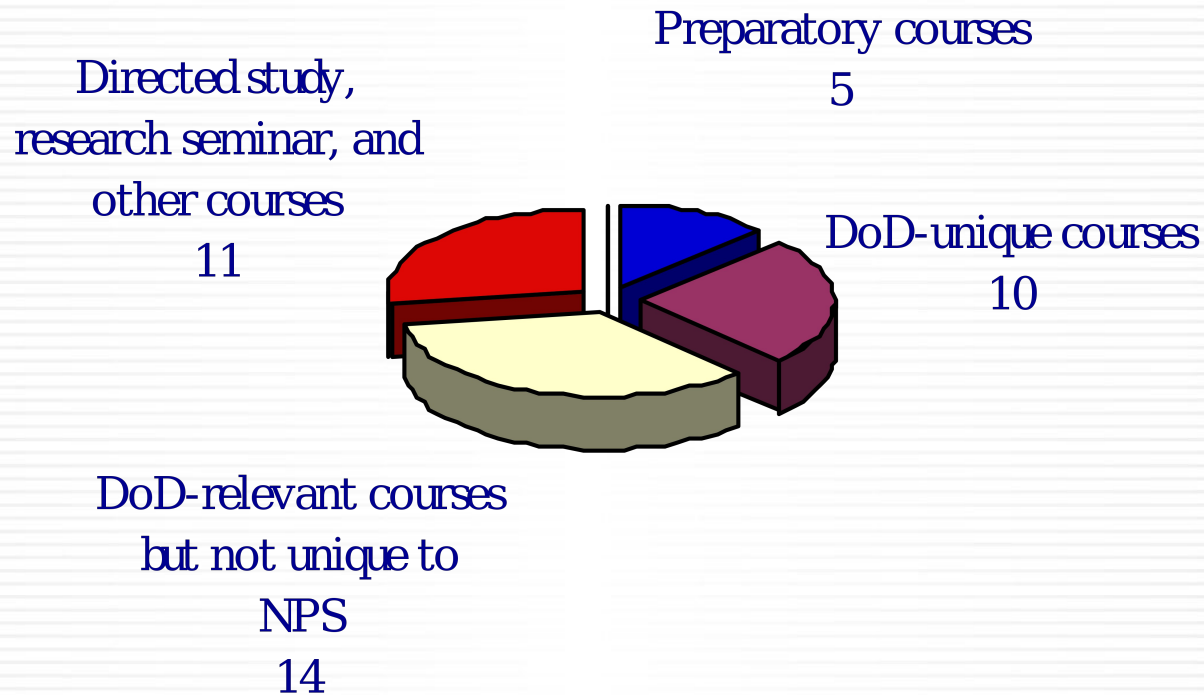
Provide the skills needed to plan, design, and implement large-scale software-intensive systems using the best available science and technology

These skills are essential for officers and civilians responsible for acquisition, development or maintenance of defense software



Software Engineering Program

There are 40 courses within the Software Engineering curriculum, the majority of which are either DoD-unique or DoD-relevant





Software Engineering Program

- These are courses that cover DoD subject matter and are not offered at other universities
 - **MN3309**, *Acquisition of Embedded Weapon Systems Software*
 - **SW4530**, *Software Engineering R&D in DOD*
 - **SW4555**, *Engineering Network Centric Systems*
 - **SW4560**, *Software Evolution*
 - **SW4582**, *Weapon System Software Safety*
 - **SW4592**, *Software Risk Assessment in DOD*
 - **SW4593**, *Advanced Logic & Algebra for Software R&D in DOD*
 - **SW4597**, *Robust Generation of Control Software*
 - **SW4599**, *Automated Software/Hardware Integration in DOD*
 - **SW4600**, *Automata, Formal Specification and Run-time Verification*



Software Engineering Program

- These are courses that place a heavy emphasis on DOD subject matter, but the course topics themselves are not unique to NPS
 - **SI4011**, *System Engineering for Acquisition Managers*
 - **IS4300**, *Software Engineering and Management*
 - **MN3331**, *Principles of Systems Acquisition and Program Management*
 - **SW4500**, *Introduction to Formal Methods in Software Engineering*
 - **SW4510**, *Computer-Aided Prototyping*
 - **SW4520**, *Advanced Software Engineering*
 - **SW4540**, *Software Testing*
 - **SW4570**, *Software Reuse*
 - **SW4580**, *Design of Embedded Real-Time Systems*
 - **SW4581**, *Software Reliability*
 - **SW4583**, *Principles of Software Design*
 - **SW4590**, *Software Architecture*
 - **SW4591**, *Requirements Engineering*
 - **SW4598**, *Software Merging and Slicing Techniques*



Software Engineering Program

- These are courses that students without a Software Engineering background or who do not have an engineering degree may need to complete before entering the master's degree or certificate programs
 - **IS3301**, *Fundamentals of Decision Support Systems*
 - **SW2920**, *Introductory Topics in Software Engineering*
 - **SW3460**, *Software Methodology*
 - **SW3800**, *Directed Study in Software Engineering*
 - **SW3920**, *Topics in Software Engineering*



MS Software Engineering (MSSWE)

Software Engineering Program

- The MSSWE degree was established at NPS in 1995
- All recipients of the MSSWE degree must
 - Become competent in Software Engineering core subjects
 - Develop advanced expertise in one or more of the following functional areas of Software Engineering:
 - Software Requirements Engineering
 - Software Design
 - Software Construction
 - Software Testing
 - Software Evolution & Maintenance
 - Software Quality Engineering
 - Software Engineering Management
 - Software Engineering Infrastructure
 - Software Engineering Process



MS Computer Science (MSCS) Software Engineering & Architecture track

Software Engineering Program

- The department also offers the MSCS Software Engineering & Architecture track, consisting of four areas of study:
 - Weapon System Software Safety
 - Software Testing
 - Weapon System Software Safety
 - Advanced Topics in System Safety and Reliability
 - Software Maintenance and Evolution
 - Computer Aided Prototyping
 - Software Evolution
 - Software Reuse
 - Software Testing and Quality Assurance Management
 - Software Testing
 - Software Reliability
 - Computer Aided Prototyping
 - Real-time System Design
 - Design of Embedded Real-time Systems
 - Computer Aided Prototyping
 - Automata, Formal Specification and Run-time Verification



PhD Program in Software Engineering

Software Engineering Program

- First doctoral program in Software Engineering in the world (established in 1998)
- Provides a unique program of study supporting the advancement of Software Engineering principles and technology to DoD researchers and practitioners, enabling them to
 - Acquire skills and knowledge needed to perform state-of-the-art research on issues related to the development of large complex software systems
 - Direct and manage teams of software professionals



Software Engineering Program

- Core subjects integrate fundamental principles:
 - Software methodology
 - Software engineering and management
 - Introduction to formal methods in software engineering
 - Principles of software design
 - Software risk assessment
- And provide problem-solving skills in areas such as:
 - Conducting capabilities-based acquisition of systems-of-systems
 - Designing mission- and safety-critical systems to be highly dependable
 - Developing open architectures
 - Using service-level agreements to procure software systems
 - Planning and managing outsourcing

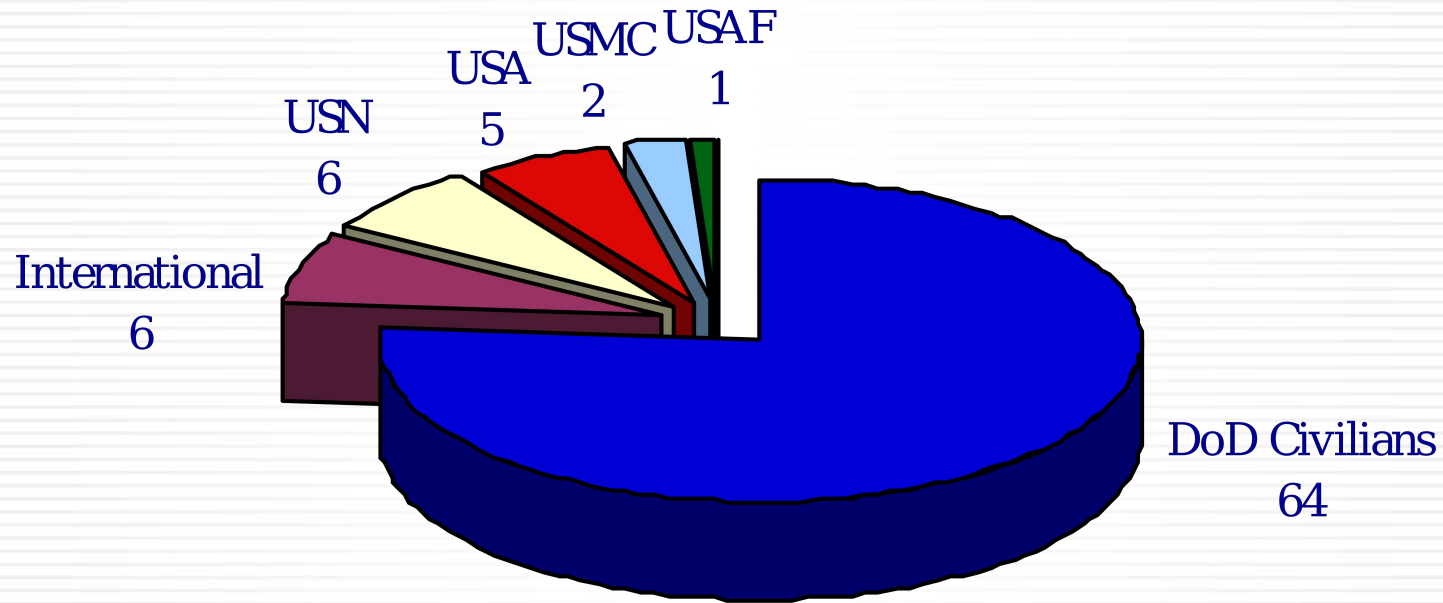
Software Engineering Program

- The Software Engineering MS and PhD curricula are
 - Fully accredited
 - Homed in the Department of Computer Science
 - 45 CS faculty, including
 - 22 tenure-track (TT) professors
 - 4 military faculty (MILFAC)
 - Faculty affiliated with the
 - Department of Information Sciences
 - Graduate School of Business & Public Policy
 - Department of Systems Engineering
 - » The faculty in these two groups provide expertise in Software Acquisition, Software Management, Software Economics, and Systems Engineering



MSSWE Graduates (since 1995)

Software Engineering Program



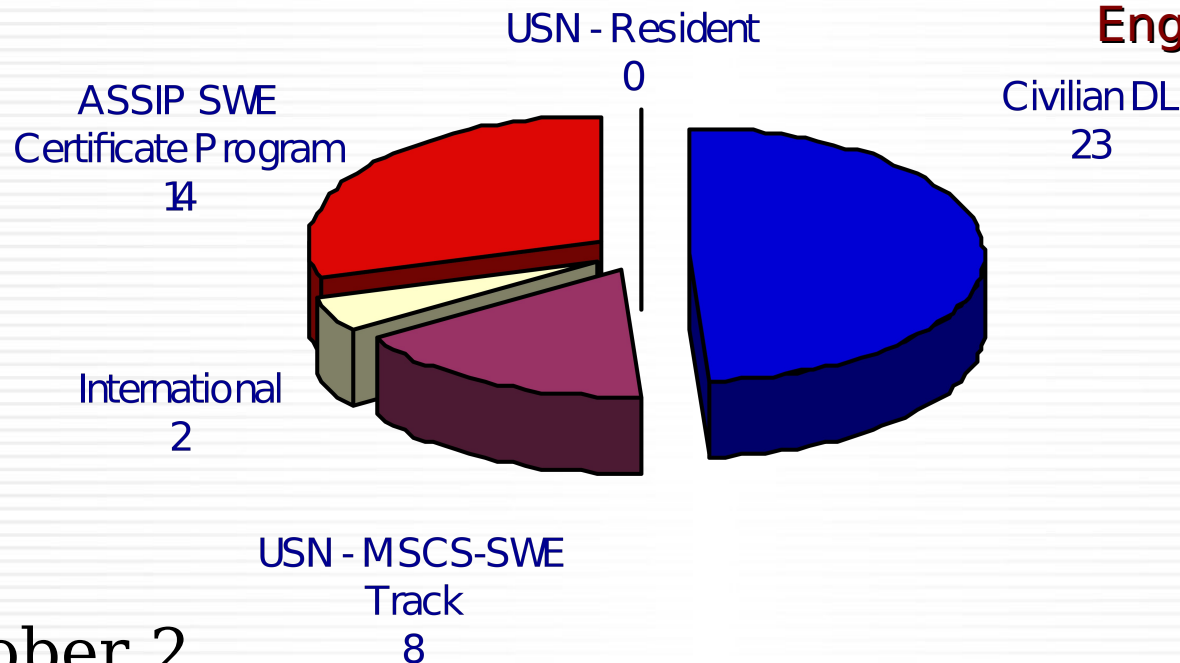


Current MSSWE Student Body

Software Engineering Program

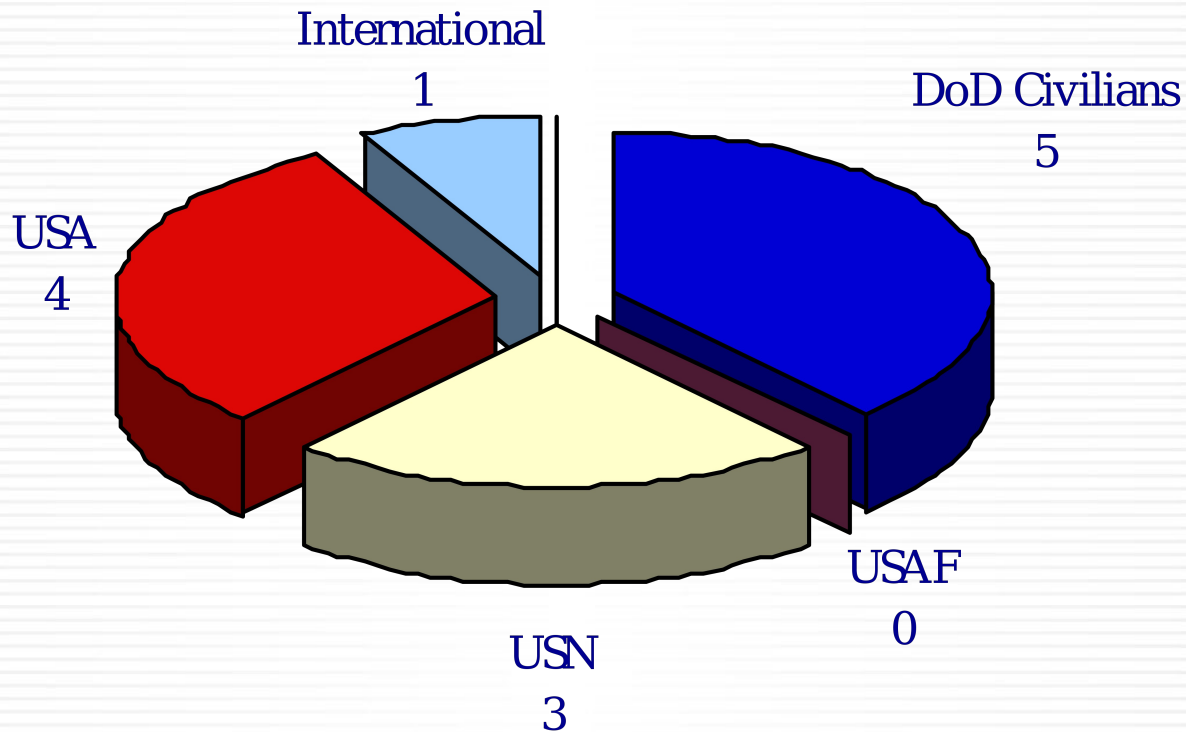
Navy EDOs and SWOs study Software Engineering at NPS in the Software Engineering track of the M.S. in Computer Science (MSCS-SWE) degree program

The USN does not send students to NPS to obtain a MS SWE degree—there is no P-Code for Software Engineering!





Software Engineering Program

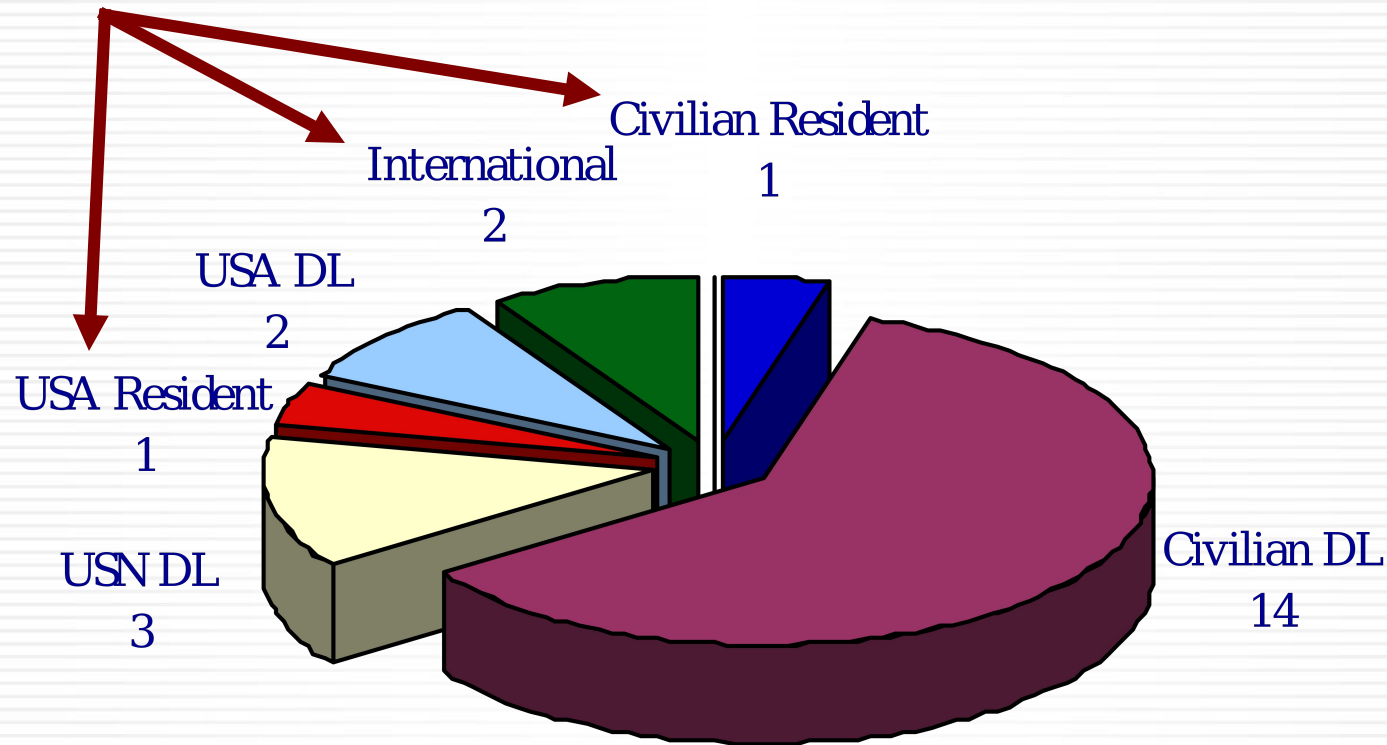




Current PHDSWE Student Body

Software Engineering Program

One full-time student each





Software Engineering Program

Committed to providing outreach with the help of Distance Learning technology...

- In addition to resident education, we deliver the same MS and PhD programs in Software Engineering via DL
- 26 faculty including most of the TT have completed IDL (Interactive Distributed Learning) course
 - Using Blackboard to host their course Web sites
- Organizations that fund students to study Software Engineering via DL include SPAWAR, NAVSEA, NSWC, NSA, MDA, Army TACOM, and Asst. Sec. of Army (ALT)
- We also conduct
 - Certificate programs
 - Short courses



Army Strategic Software Improvement Program (ASSIP)

Software Engineering Program

- In 2004, NPS established a certificate program in Software Engineering for the Army Strategic Software Improvement Program (ASSIP)
 - Sponsored by the Office of the Assistant Secretary of the Army, Acquisition, Logistics, and Technology
 - The students are DoD civilians who serve in key software acquisition roles
 - We tailor each certificate course of study to the sponsor's needs
 - Each certificate course of study consists of a sequence of four courses
 - Current cohort (Academic Year 2006) of students are enrolled in the Weapon System Software Safety certificate program of study
 - Students can apply three certificates (i.e., twelve courses) toward completing the requirements for the MSSWE—the other requirement is to complete an acceptable thesis



Examples of Recent Doctoral Dissertations

Software Engineering Program

- Developing Dependable Software for a System-of-Systems
 - Dr. Butch Caffall, HQ Missile Defense Agency
- Evolving a Simulation Module Product Line Software Architecture from heterogeneous Model Representations
 - Dr. Kevin Greaney (COL, USA Ret.)
- Improving Software Quality and Management through the Use of SLAs
 - CDR Leonard Gaines, USN, HQ Defense Logistics Agency
- A Formal Application of Safety and Risk Assessment in Software Projects
 - CDR Christopher Williamson, USN



Examples of Recent Master's Theses

Software Engineering Program

- A Test Methodology for Reliability Assessment of Collaborative Tools
 - Ms. Brenda Powers, SPAWAR
- Convergence of the Naval Information Infrastructure
 - LCDR James Knoll, USN
- A Methodology for Developing Timing Constraints for the Ballistic Missile Defense System
 - CDR Michael Miklaski, USN and CPT Joel Babbitt, USA
- Extending the Computer-aided Software Evolution System (CASES) with Quality Function Deployment (QFD)
 - MAJ Arthur Clomera, USA

Software Engineering Program

The Department of Computer Science's New *State-of-the-Art* Facilities



- Modeled after Stanford University's Center for Innovations in Learning
- Represents over \$12 million in new MILCON construction
 - Scheduled for completion in 2006
- Over 32,000 sq. ft. of new space
 - 12,000 of it dedicated to DoD-funded research
 - 11 new labs utilized for research in Software Engineering and Computer Science
- Will include the latest in technology for
 - VTE (Video Tele-Education) and Smart-classroom

October 2, 2006



Supporting NPS Value Propositions

Software Engineering Program

- Civilians obtain the problem-solving skills and knowledge they need to engineer and manage DoD software-intensive systems
- Military officers receive a first-class education while immersed in military values and culture, significantly enhancing retention
 - Approximately 25% of flag officers have NPS degrees
- Approximately 90% of SWE students enter the Software Engineering program with experience in leading or managing a defense software development or maintenance program
- Many of our MS theses and PhD dissertations save external sponsors millions in consulting fees by providing studies -- NPS is a think tank



Software Engineering Program

- We propose that the Navy Software Process Improvement Working Group
 - Take ownership of NPS' Software Engineering Program in order to champion one or both of the following:
 - Finding a Navy sponsor for the program
 - Agreeing on Engineering Skill Requirements (ESRs) for military officers and securing a P-Code (postgraduate education designator) for Software Engineering
 - This is needed in order to create billets and quotas for the Navy to send its officers to NPS to study Software Engineering
 - Take a leadership role in increasing the enrollment of members of the DoD civilian workforce in the resident and distance learning offerings of the Software Engineering program
 - The Naval Education and Training Command (NETC) will most likely not continue to subsidize NPS' DL programs when the Navy-wide 10% cut in funding takes effect this fiscal year
 - The curriculum is already in place, but is at present underutilized by the DoN and DoD



Discussion...

Future role of NPS' Software Engineering resident and distance learning programs in supporting Navy and DoD objectives, including software process improvement initiatives